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On the Eye and the Organ of Hearing in the Blind Fishes (Amblyopsis spelæus, Dekay) *of the Mammoth Cave.*

By Jeffries Wyman, M.D.

The general structure of the blind fishes was described in a former number of this Journal,* but a more complete description was given in the New York Journal of Medicine, by Telkampf, who in company with J. Muller of Berlin, for the first time detected the existence of rudimentary eyes.† They are described as one twelfth of a line in diameter, round, black, destitute of a cornea, having an external layer of pigment, beneath which is a colorless membrane. No nerve was detected in connection with the eye, and the contents of the globe were not determined with certainty. Prof. Owen has described the organ as a simple eye-speck, "as in the leech, consisting of a minute tegumentary follicle, coated by dark pigment which receives the end of a special cerebral nerve."‡ Dr. John C. Dalton, Jr. has also detected the eyes and describes them as minute globular sacs containing blackish pigment, deeply imbedded in the adipose tissue of the orbit and measuring a little less than one seventy-eighth of an inch.§

Through the kindness of Mr. Charles Dean of Cambridge, and of Prof. Agassiz, I have had placed at my disposal some specimens of Amblyopsis, well preserved in alcohol, and have been able to make in some respects a more complete description than has as yet been given. I have had also an opportunity of inspecting superficially fourteen specimens varying from one inch and a half to four inches and a half in length, but in three or four only

* Vol. xlv, p. 94, July, 1843.

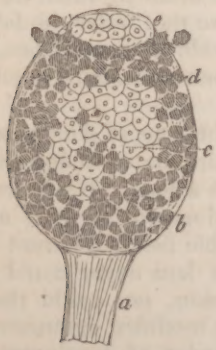
† New York Journal of Medicine, vol. v, p. 84, 1845. Dr. Dekay had previously mentioned the existence of eyes, but was evidently misled by some other appearance, since he states that eyes exist of the usual size, but are covered by the skin. He had not dissected them. Fauna of New York.

‡ Lectures on Comp. Anat., vol. ii, p. 202. See also his figure, p. 175.

§ New York Medical Times, vol. ii, p. 354.

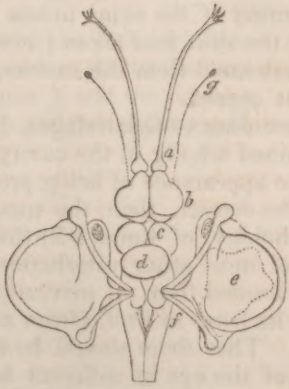
could the eyes be detected through the skin. In the three specimens recently dissected, the eyes were exposed only after the removal of the skin, and the careful separation from them of the loose areolar tissue which fills the orbit. In a fish four inches in length the eyes measured one-sixteenth of an inch in their long diameter, were of an oval form and black. A filament of nerve (fig. 1*a*) was distinctly traced from the globe to the cranial walls, but the condition of the contents of the cranium from the effects of the alcohol, was such as to render it impracticable to ascertain the mode of connection of the optic nerve with the optic lobes. A few muscular fibres were traced to the immediate neighborhood of the eye, and even in contact with it, but were not ascertained to have that regular arrangement which is seen in the more completely formed eyes of other fishes.

1.



Eye of Amblyopsis.

2.



Brain and auditory apparatus.

Examined under the microscope with a power of about twenty diameters, the following parts were satisfactorily made out: 1st, externally an exceedingly thin membrane, *b*, which invested the whole surface of the eye and appeared to be continuous with a thin membrane covering the optic nerve, and which was therefore regarded as a sclerotic; 2d, a layer of pigment cells, *d*, for the most part of a hexagonal form, and which were most abundant about the anterior part of the eye; 3d, beneath the pigment a single layer of colorless cells, *c*, larger than a pigment cell, and each cell having a distinct nucleus; 4th, just in front of the globe, a lenticular shaped, transparent body, *e*, which consisted of an external membrane containing numerous cells with nuclei. This lens-shaped body seemed to be retained in its place by a prolongation forwards of the external membrane of the globe; 5th, the globe was invested by loose areolar tissue, which adhered to it very generally, and in some instances contained yellow fatty matter; in one specimen it formed a round spot visible

through the skin on each side of the head, which had all the appearance of a small eye;—its true nature was determined by the microscope only. It is not improbable that the appearance just referred to may have misled Dr. Dekay—where he states that the eye exists of the usual size, but covered by the skin.

If the superficial membrane above noticed is denominated correctly the *sclerotic*, then the pigment layer may be regarded as the representation of the *choroid*. The form as well as the position of the transparent nucleated cells within the choroid correspond for the most part with the *retina*. All of the parts just enumerated are such as are ordinarily developed from and in connection with the encephalon, and are not in any way dependent upon the skin. But if the lenticular shaped body is the true representative of the crystalline lens, it becomes difficult to account for its presence in Amblyopsis according to the generally recognized mode of its development (since it is usually formed from an involution of the skin) unless we suppose that after the folding in of the skin had taken place in the embryonic condition, the lens retreated from the surface, and all connection with the integument ceased.

According to Quatrefages, however, the eye of Amphioxus is contained wholly in the cavity of the dura mater, and yet it has all the appearance of being provided with a lens. If his description be correct, then the mode of development as well as the morphology of the eye in this remarkable fish is different from that of most other vertebrates, since the lens never could have been formed from an involution of the skin, nor could the eye with its lens, as Prof. Owen asserts, be a modified cutaneous follicle. That there should be different modes of development of parts of the eye in different animals is by no means improbable, since we find this actually to be the case in another organ of sense, the nose. In some fishes the nostrils result from a depression or involution of the skin simply, and do not at any period communicate with the mouth; while in all of the higher vertebrates they are formed by subdivision of the primitive oral cavity. It is possible, therefore, that in Amblyopsis the lens may have been developed where we find it, and that it was never connected with the integument. Whatever views be taken with regard to its development, the anatomical characters which have been enumerated show, that though quite imperfect as we see it in the adult, it is constructed after the type of the eyes of other vertebrates. It certainly is not adapted to the formation of images, since the common integument and the areolar tissue which are interposed between it and the surface would prevent the transmission of light to it except in a diffused condition. No pupil or anything analogous to an iris was detected, unless we regard as representing the latter the increased number of pigment cells at the anterior part of the globe.

The Ear.—It is said that the blind fishes are acutely sensitive to sounds as well as to undulations produced by other causes in the water. In the only instance in which I have dissected the organ of hearing (which I believe has not been before noticed) all its parts were largely developed, as will be seen by reference to figures 2 and 3. As regards the general structure, the parts do not differ materially from those of other fishes except for their proportional dimensions. The semi-circular canals are of great length, and the two which unite to enter the vestibule by a common duct, it will be seen, project upwards and inwards under the vault of the cranium, so as to approach quite near to the corresponding parts of the opposite side. The otolite contained in the utricle was not remarkable, but that of the vestibule (fig. 3) andwhich is seen in dotted outline in fig. 2 *e* is quite large when compared with that of a Leuciscus of about the same dimensions as the blind-fish here described.

3.

Otolite.

The parts represented in fig. 2 are the olfactory lobes and nerves *a*, the cerebral lobes *b*, optic lobes *c*, the cerebellum *d*, the otolite in situ *e*, the medulla oblongata *f*, and the eyes *g*.

The parts in figures 2 and 3 are enlarged three times linear measurement.